

REMARKS

Attached hereto is a marked-up version of the changes made to the application by this Amendment. Reconsideration and allowance of the subject application are respectfully requested.

Upon entry of this Amendment, claims 1-11 and 13-31 will be pending in the present application. Claims 1, 22 and 30 are independent claims. Claim 31 has been added, and claims 13 and 17-19 have been amended by this Reply.

Priority Under 35 U.S.C. § 119

Applicant thanks the Examiner for acknowledging Applicant's claim for foreign priority under 35 U.S.C. § 119, and receipt of the certified priority document.

Rejection Under 35 U.S.C. § 112, 2nd Paragraph

Claims 13 and 17-19 stand rejected under 35 U.S.C. § 112, 2nd Paragraph. This rejection is respectfully traversed.

The Examiner has set forth certain instances wherein the claim language lacks antecedent basis or is not clearly understood.

In order to overcome this rejection, Applicant has amended claims 13 and 17-19 to correct each of the deficiencies specifically pointed out by the Examiner. Applicant respectfully submits that the claims, as amended, particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

Rejections Under 35 U.S.C. § 103

Hirano in View of Chen

Claims 1, 2, 5-9, 11,13, 15, 16, 20-22, 24 and 28-29 stand rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,771,110 to Hirano et. al. (Hirano) in view of U.S. Patent No. 6,133,145 to Chen, for the reasons set forth in paragraph 4 of the Office Action. This rejection is respectfully traversed.

The Examiner admits that Hirano fails to teach treating the exposed portion of the metal layer with a first plasma, prior to etching, and relies on Chen to fill this vacancy.

Applicant urges the Examiner to acknowledge the distinction between “etching” and “prior to etching.” It is well known in the art that etching necessary includes removal of a portion of the material being etched. The Examiner has asserted that treating an exposed surface to a plasma gas

inherently lowers a binding force. A point of contention here, from the Applicant's point of view, is whether lowering of a binding force occurs during a step of etching, or "prior to" any step that is designated as a step of etching.

Chen is directed to a plasma treatment, applied to a photoresist shape, prior to a second metal etch cycle. The plasma treatment of the photoresist shape does not lower a binding force, but actually increases a binding force in the photoresist shape, while maintaining the same removal rate of the exposed metal (see Chen, Col.1, lines 29-35).

The Examiner relies on the discussion Col.4, lines 13-24 of Chen to support a rejection of the independent claims. Here too, the central question is whether lowering a binding force takes place during etching or prior to etching. The relied on portion of Chen recites the following:

A first cycle of the RIE procedure is again performed, in a RIE system, using $\text{Cl}_2 - \text{BCl}_3$ as an etchant, creating second titanium nitride shape 11b, underlying photoresist shape 12b, schematically shown in FIG. 5. Photoresist shape 12b, has been thinned during the first cycle of the RIE procedure, to a thickness between about 6000 to 15000 Angstroms. At this stage of the RIE procedure, an in situ, plasma treatment, is performed in a nitrogen containing ambient, resulting in a surface of photoresist shape 12b, that will be more resistant to the subsequent second cycle, or main etch cycle, of the RIE procedure.

Chen, Col.4, lines 13-24

During the first etch cycle, titanium nitride layer 11a is etched to result in nitride shape 11b. Photoresist shape 12b (designated in Fig. 4 as 12a) has also been etched at the same time as titanium nitride layer 11a (now 11b). This is evident in that the thickness has been reduced from between about 6500-20000 Angstroms to between about 6000 to 15000 Angstroms. The above-recited portion of Chen describes a first and second cycle. If a question remains as to whether the first and second cycles are RIE (etching) procedures, the answer is an unequivocal yes. In fact, the above-recited portion of Chen describes the process as an **RIE procedure, performed in an RIE system**. In view of the above discussion, the only reasonable conclusion is that the process described takes place during (not prior to) a step of etching. Further, photoresist pattern 12a (12b after etching) is etched prior to any incident exposure of a metal layer to a first plasma.

Therefore, Chen does not disclose or suggest treating the exposed portion of the metal layer with a first plasma, prior to etching said photoresist pattern and said metal layer, using the photoresist pattern as a mask, to lower a binding force in the exposed portion, as recited in independent claim 1, as amended, and similarly stated in claims 22 and 30 (as amended).

Claims 2, 5-9, 11, 13, 15, 16, 20, 21, 24, 28 and 29 depend, either directly or indirectly, on claims 1, 22, and 30. Since neither Hirano, nor Chen disclose or suggest the features of independent claims 1, 22 and 30 either singly or in combination, Hirano, in view of Chen cannot render claims 1, 2, 5-9, 11-13, 15, 16, 20-22, 24, 28 and 29 obvious to one of ordinary skill in the art. Reconsideration and withdrawal of the art grounds of rejection are respectfully requested.

Hirano and Chen in View of Ye

Claims 10, 17-19 and 25-27 stand rejected under 35 U.S.C. 103(a) over Hirano and Chen (as applied to claims 1, 7, 22 and 30 in view of U.S. Patent No. 5,968,847 to Ye et al. (Ye). This rejection is respectfully traversed.

Hirano and Chen (argued above) does not disclose or suggest treating the exposed portion of the metal layer with a first plasma, prior to etching of said photoresist pattern and said metal layer, using the photoresist pattern as a mask, to lower a binding force in the exposed portion, as recited in independent claim 1, and similarly stated in claims 22 and 30. Ye cannot fill this vacancy.

Claims 10, 17-19, and 25-27, depend on claims 1, 22, and 30. Since neither Hirano, nor Chen, nor Ye discloses or suggests the features of independent claims 1, 22, and 30, Hirano and Chen in view of Ye cannot

render claims 10, 17-19 and 25-27 obvious to one of ordinary skill in the art. Reconsideration and withdrawal of this art grounds of rejection is respectfully requested.

Added Claims

Claim 31, added for the Examiner's consideration, recites a combination of elements including forming a photoresist pattern adjacent to the metal layer, leaving a portion of the metal layer uncovered. Applicant submits that the above recited feature of claim 31 is not disclosed or made obvious by the prior art of record. Allowance of claim 31 is respectfully requested.

Conclusion

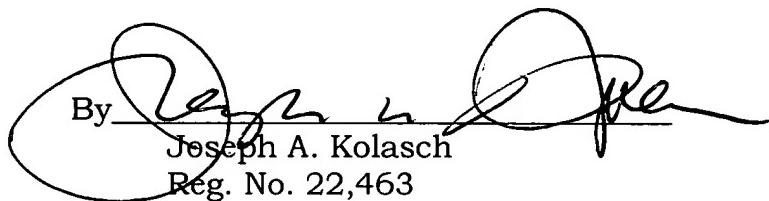
Applicant considers all of the Examiner's comments to have been addressed and all of the Examiner's rejections overcome, thereby placing all claims pending in the present Application in condition for allowance. Accordingly, a Notice of Allowability is solicited in earnest.

In the event that any outstanding matters remain in this application, Applicant requests that the Examiner contact Percy L. Square (Reg. No. 51,084) at (703) 205-8034 to discuss such matters.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Claims:

The claims have been amended as follows:

1. (Twice Amended) A method of manufacturing a liquid crystal display device, comprising:

forming a switching element on a substrate;

forming a passivation layer over the substrate;

depositing a metal layer on the passivation layer;

forming a photoresist pattern on the metal layer, such that a portion of the metal layer is exposed;

treating the exposed portion of the metal layer with a first plasma, prior to etching said photoresist pattern, and prior to etching said metal layer, using the photoresist pattern as a mask, to lower a binding force in the exposed portion; and

etching the treated portion of the metal layer to form a pixel electrode.

13. (Amended) The method of claim 30, wherein the first gas [plasma] is a reactive gas.

17. (Amended) The method of claim 30, wherein the at least one second gas [plasma] includes HBr plasma gas.

18. (Amended) The method of claim 30, wherein the at least one second gas [plasma] includes a composition of HBr plasma gas and Cl₂ plasma gas.

19. (Amended) The method of claim 30, wherein the at least one second gas [plasma] the at least one second gas [plasma] includes a composition of HBr plasma gas and CH₄ plasma gas.

22. (Twice Amended) A method of patterning a metal layer, comprising:
depositing a metal layer over a substrate;
forming a mask on the metal layer, leaving a portion of the metal layer uncovered;
exposing the uncovered portion of the metal layer to a first plasma, prior to etching said mask, and prior to etching said metal layer, to lower a binding force in the uncovered portion; and
etching the uncovered portion of the metal layer with a second plasma to form a metal pattern.

30. (Amended) A method of manufacturing a pixel electrode in a liquid crystal display device, comprising:
depositing a metal layer on a passivation layer which partially covers a transistor;
forming a photoresist pattern on the metal layer, leaving a portion of the metal layer uncovered;
exposing the uncovered portion of the metal layer to at least one first gas, prior to etching said photoresist pattern and prior to etching said metal layer, to lower a binding force in the uncovered portion; and
etching the uncovered portion of the metal layer with at least one second gas to form a pixel electrode.

Claim 31 has been added.